Remarks

In view of the above amendments and the following remarks, reconsideration of the outstanding office action is respectfully requested.

Initially, applicants would like to note that the present amendment is being submitted in compliance with "Amendments In A Revised Format Now Permitted", 1267 OG 4 (February 25, 2003). Pursuant to this notice, the requirements of 37 C.F.R. § 1.121 have been waived.

The present invention relates to a novel process and novel products formed by that process. The process overcomes several deficiencies in the prior art, one of which is that a temperature of at least 700°C had previously been required to induce carbon nanotube growth. Unfortunately, this high temperature requirement limits substrate selection. This deficiency in the art is apparent when considering the types of glass employed in flat panel displays. Of glasses used in flat panel displays, a glass produced by Corning Incorporated (Corning, New York) has the highest known glass deformation or strain point temperature of 666°C. Typically, a commercially available flat panel display glass has a strain point temperature between 500°C and 590°C. Thus, at 700°C and above, these types of glass substrates will deform and, as a result, inhibit aligned carbon nanotube growth. The present invention overcomes this deficiency by affording growth of carbon nanotubes directly on a substrate whose strain or melting point temperature is less than 700°C. As a result, products containing carbon nanotubes that were not previously available, such as flat panel displays, can be prepared with the present invention.

The rejection of claims 37 under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 5,547,343 to Ajayan et al. ("Ajayan") is respectfully. It appears to be the position of the U.S. Patent and Trademark Office ("PTO") that Ajayan inherently teaches all of the limitation of claim 37. For the reasons of record and as set forth below, applicants respectfully disagree.

Claim 37 presently recites: "A product comprising: a substrate having a strain point or a melting point temperature between about 300°C and 700°C and one or more carbon nanotubes formed on and extending outwardly from an outer surface of the substrate." Thus, claim 37 recites certain properties of the substrate and also identifies the relationship between the substrate and the one or more carbon nanotubes.

Ajayan is deficient in several respects.

Firstly, the product of Ajayan cannot be said to contain "one or more carbon nanotubes formed on and extending outwardly from" the substrate. The product of Ajayan contains carbon nanotubes merely "arranged" on the substrate (Ajayan, col. 12, line 51). The carbon nanotubes are clearly not formed on the substrate itself. Elsewhere Ajayan states that the carbon nanotubes are arranged by "[a] magnetic field ... applied on the glass substrate 31 for an application of the solvent including the carbon tubules 32 enclosing the magnetic material on the glass substrate 31 and a subsequent dry treatment thereof" (Ajayan, col. 12, lines 62-65). Thus, it is abundantly clear that the product of Ajayan does not contain one or more carbon nanotubes formed on the surface of the substrate.

Secondly, Ajayan does not teach, either literally or inherently, a substrate having a strain point or melting point temperature within the claimed range ("between about 300°C and 700°C"). While Ajayan illustrates a plurality of nanometer sized carbon tubules enclosing gadolinium and cobalt, which are arranged in an array on a glass substrate (see Ajayan, Figure 3 and col. 12, lines 50-53), it cannot be said that the glass substrate of Ajayan inherently possesses the characteristics as presently recited in the claimed invention.

The standard for determining inherency, as adopted by the Federal Circuit in Continental Can Co. USA, Inc. v. Monsanto Co., is as follows:

> Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. If, however, the disclosure is sufficient to show that the natural result flowing from the operation as taught would result in the performance of the questioned function, it seems to be well settled that the disclosure should be regarded as sufficient.

948 F.2d 1264, 1268-69, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991) (emphasis in original) (citing In re Oelrich, 666 F.2d 578, 581 (CCPA 1981)). Applicants submit that Ajayan leaves much open to speculation as to whether the glass substrate, illustrated in Figure 3 and described in Example 12 thereof, necessarily possesses the claimed strain point or melting point temperature. After all, different glass compositions will have different characteristics, including strain point and melting point temperatures. Because Ajayan neither identifies the contents of the glass substrate nor subjects the glass substrate in Example 12 to heating of any kind, there is no basis to conclude that the glass substrate necessarily has a strain point or melting point temperature within the claimed range. That the glass substrate could possibly have a strain point or melting point temperature within the claimed range, however, is irrelevant. See In re Oelrich, 666 F.2d 578, 581, 212 USPQ 323, 326 (CCPA 1981) (holding

that inherency must flow as a necessary conclusion from the prior art, not simply a possible one).

While it is clear that applicants and the PTO dispute whether it is the PTO's burden in demonstrating the factual basis for anticipation by inherency, applicants submit that the Manual of Patent Examining Procedure clearly places that burden on the PTO (see MPEP § 2112). In any event, from the foregoing applicants have demonstrated that the feature of the presently recited substrate is not an inherent feature of Ajayan.

For all of these reasons, the rejection of claim 37 should be withdrawn.

The rejection of claim 78 under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 5,726,524 to Debe ("Debe") is respectfully traversed.

Debe teaches an electron field emission display including an electrode comprising as cathode a layer comprising a dense array of discrete solid microstructures disposed on at least a portion of one or more surfaces of a substrate, with at least a portion of the microstructures being conformally overcoated with one or more layers of an electron emitting material (Debe, col. 2, lines 39-48). Debe teaches using organic and inorganic materials (including glasses, ceramics, metals, and semiconductors) as substrate materials (Debe, col. 8, lines 27-30). The microstructures are formed of an organic material, which is deposited as a thin layer onto the substrate and then annealed to form microstructures thereon (Debe, col. 8, lines 12-21 and 50-61). Debe lists a number of polymeric and pre-polymeric organic materials at col. 8, line 62 to col. 9, line 11; however, Debe notes that the microstructures are not formed of carbon *per se*. Rather, Debe specifically states that "the chemical composition of the organic-based microstructured layer will be the same as that of the starting material" (col. 9, lines 12-14). This is in sharp contrast to the carbon nanotubes formed according to the present invention, which—having been formed from a carbon source gas as described at page 9, lines 26-28 of the present application—are truly carbon nanotubes.

Despite these teachings of Debe, the PTO has taken the position that "Debe does teach a baseplate having a carbon nanotubes" (citing Debe at col. 7, lines 34-44; col. 8, lines 22-43; col. 9, lines 1-35; col. 14, lines 38-67; and Figs. 3A-B) (office action at page 5). Applicants respectfully disagree, because neither the cited text nor the cited figures of Debe identify the microstructures as being formed of carbon. In fact, as noted above, the cited text at col. 8 line 62 to col. 9, line 41 makes clear that the microstructures are formed of any of a variety of organic materials other than carbon. A careful reading of the cited text shows that carbon is nowhere listed as the material used to form the microstructures of Debe.

Because Debe fails to teach or suggest a baseplate having a carbon nanotube (i.e., as opposed to a microstructure formed of a polymer or pre-polymer organic material), Debe cannot anticipate claim 78. Therefore, the rejection of claim 78 is improper and should be withdrawn.

The rejection of claims 1-37 under 35 U.S.C. § 103(a) for obviousness over Ajayan in view of Chen et al., "Well-aligned Graphitic Nanofibers Synthesized by Plasma-Assisted Chemical Vapor Deposition," Chemical Physics Letters 272:178-182 (1997) ("Chen") is respectfully traversed.

Ajayan is cited substantially as described above.

Chen reports the preparation of carbon nanotubes on a nickel wafer using mixed nitrogen and methane gases during plasma-assisted hot filament chemical vapor deposition (Chen, page 179, first column). During the nucleation stage, when plasma is generated, the substrate temperature reached 900-950 °C (Id.). During the fiber growth stage, substrate temperature was reduced to about 800 °C (Id.). Chen also notes that these temperatures are necessary, because "[n]o carbon fibers can be grown if the temperature drops below 900 °C in conventional CVD using methane as the carbon source" (Chen, page 182, first column).

Firstly, applicants submit that the teachings of Ajayan and Chen cannot be combined. As noted above, Ajayan involves the preparation of products having nanotubes "arranged" thereon by a solvent deposition process (that involves applying the solvent containing metal-filled nanotubes under magnetic field conditions). In contrast, Chen involves the formation of nanotubes directly onto a nickel wafer using plasma-assisted hot filament chemical vapor deposition. Thus, the processes involved in Ajayan and Chen relate to the formation of two very distinct products. Because the products themselves are very different and the techniques used to form those products are very different, one of ordinary skill in the art would not have been motivated to combine their teachings.

Secondly, applicants submit that properties of the substrate as recited in claims 1, 21, and 37 is not an inherent feature of the substrates described in Chen et al. or Ajayan et al. Applicants have already demonstrated above that the claimed strain point or melting point temperature range is not inherent in Ajayan. Ajayan simply fails to provide any basis for the conclusion that the glass substrate (described in Example 12 of Ajayan) necessarily has a strain point or melting point temperature as claimed and the PTO has provided no evidence in support of its position. Chen actually teaches away from the use of a substrate having strain point or a melting point temperature between about 300 °C and 700 °C. Chen utilized a

nickel substrate; it is well known that nickel has a melting point of about 1455 °C. The substrate temperature which Chen utilized in preparing the carbon nanotubes was about 900-950 °C during the nucleation stage (Chen, page 179, first column) and 800 °C during the fiber growth stage (Id.). Chen also states that these temperatures are necessary, because "[n]o carbon fibers can be grown if the temperature drops below 900 °C in conventional CVD using methane as the carbon source" (Chen, page 182, first column). Given the process requirements of Chen, Chen fails to provide any motivation for modifying the process to allow its use on otherwise unsuitable substrates. Thus, both references fail to teach or suggest, either literally or inherently, the properties of the substrate.

Moreover, whether a feature is inherent in a prior art reference is irrelevant to the question of obviousness. It has been repeatedly stated by the Court of Claims and Patent Appeals, predecessor of the Federal Circuit, that a feature "which may be inherent is not necessarily known" and that "obviousness cannot be predicated on what is unknown." In re Shetty, 566 F.2d 81, 86, 195 USPQ 753, 757 (CCPA 1977) (quoting from In re Spormann, 363 F.2d 444, 448, 150 USPQ 449, 452 (CCPA 1966)).

Thus, one of ordinary skill in the art would not have chosen a glass substrate having a strain point or melting point temperature as recited in claims 1, 21, and 37. As noted in the present application at page 2, lines 21-30, high temperature requirements for previously reported methods of carbon nanotube formation had limited the choice of suitable substrates, particularly with regard to flat panel displays. A glass produced by Corning Incorporated (Corning, New York) had, at least at the time the present application was filed, the highest known flat panel display glass deformation or strain point temperature of 666 °C (Id.). Typically, commercially available flat panel display glass have a strain point temperature between 500 °C and 590 °C (Id.). If materials such as these were to be employed as substrates in the process of Chen, which utilized temperatures of about 900-950 °C during the nucleation stage (Chen, page 179, first column) and 800 °C during the fiber growth stage (Id.), then the glass substrate likely would have deformed, inhibiting aligned carbon nanotube growth. As noted at page 1, lines 14-23 of the present application, maintaining the aligned carbon nanotube growth is important for flat panel displays and other products. Thus, the process as taught by Chen would have been unsuitable for use in preparing a product as presently recited in claims 1, 21, and 37.

The rejection of claims 87-89 under 35 U.S.C. § 103(a) for obviousness over Ajayan in view of Chen is respectfully traversed. The teachings of Ajayan and Chen are set

forth above. Because claims 87-89 depend from claim 1 and claim 1 is non-obvious for the reasons noted above, applicants submit that the rejection of claims 87-89 is likewise improper.

In view of the all of the foregoing, applicants submit that this case is in condition for allowance and such allowance is earnestly solicited.

Respectfully submitted,

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